Audiology 25th Anniversary Research Symposium
Auckland
September 11th, 2015

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CHRISTCHURCH NEW ZEALAND

Adult cognition and hearing aids

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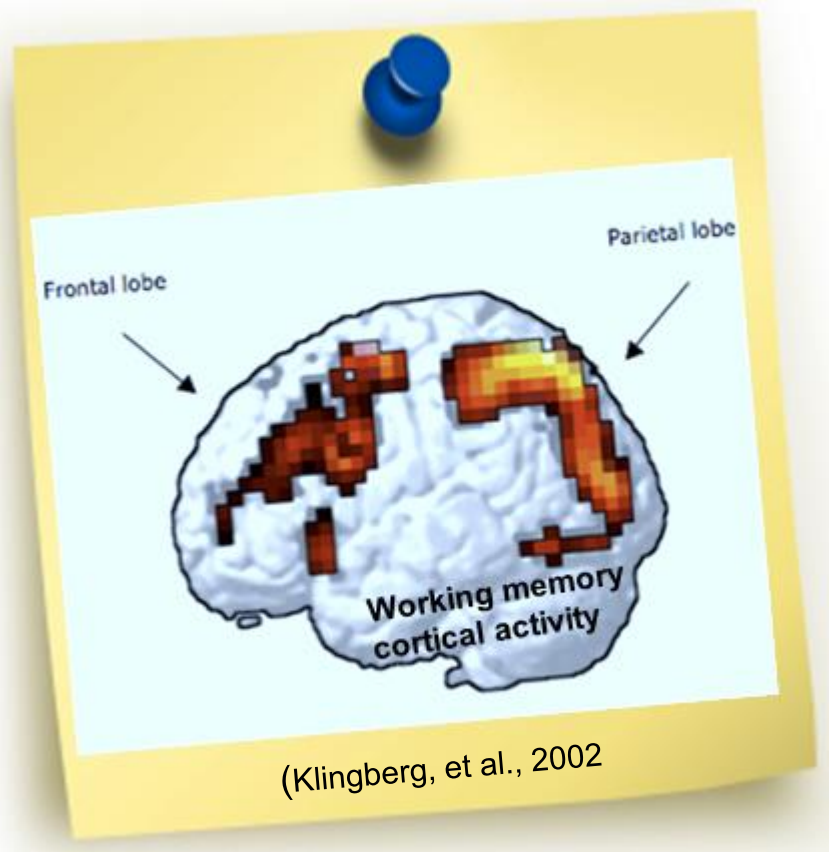
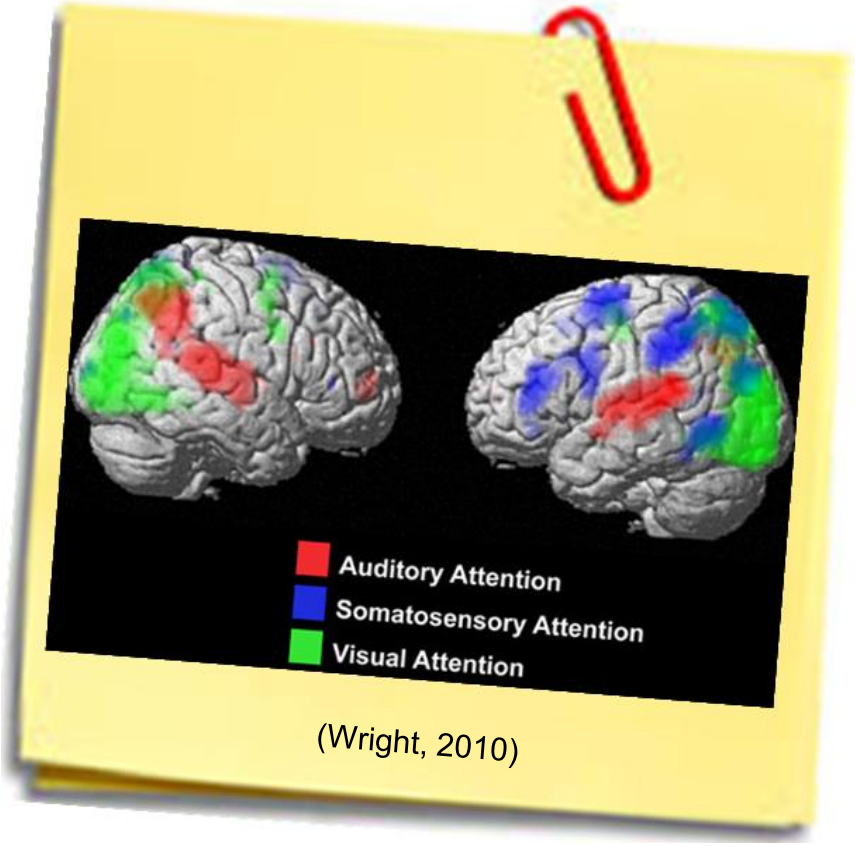
Working memory & selective attention



(Klingberg, et al., 2002



(Wright, 2010)

Cognitive aging & executive processes

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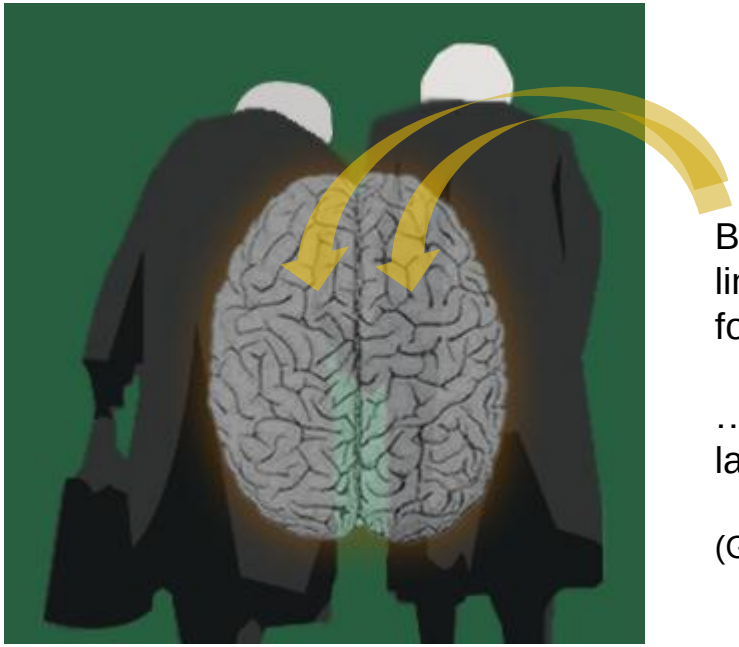
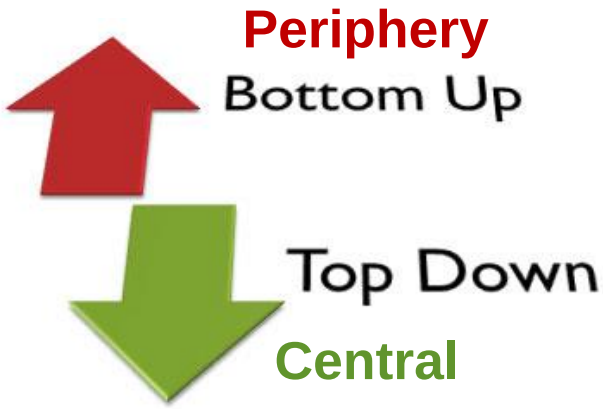


Bilateral prefrontal activity linked with working memory for older adults

…this activity is usually lateralised in younger adults

(Goh, 2011)



Hearing aids and cognitive aging

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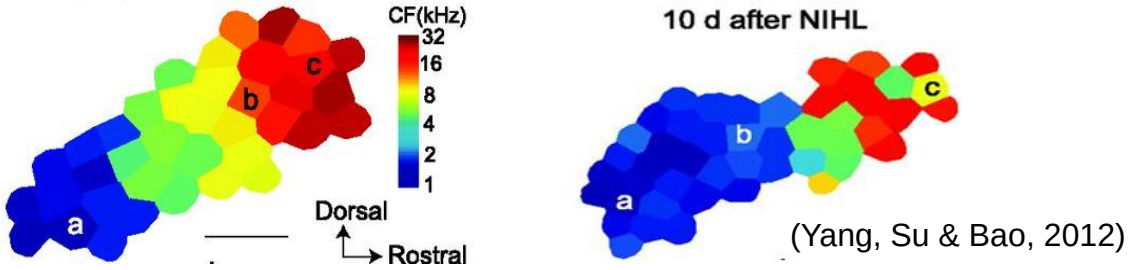

(Yang, Su & Bao, 2012)

Lin et al., 2011 (Baltimore, US; Longitudinal Study N = 639; mean follow-up 11.5 years) – "Hearing loss independently associated with incident, [all-cause] dementia. Whether hearing loss is a marker for early stage dementia or a modifiable risk factor, deserves further study."

Lin et al., 2013 (Pittsburgh and Memphis, US; N = 1,984 older adults - mean age 77.4 years) – " Hearing loss is independently associated with accelerated cognitive decline and incident cognitive impairment in community-dwelling older adults."

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Research Forum: The Brain And Hearing Aids

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Outline of the present study

Will aiding measurable hearing loss decrease or arrest cognitive decline?

Would selective attention & working memory improve following a standard hearing aid trial?

Participants – experimental group

Allen et al., 2010 (n = 960)

Decade	Flat	Gently Sloping	Steeply Sloping
20 (18–24)	49/46	0/0	0/0
30 (25–34)	11/7	0/0	0/0
40 (35–44)	10/16	0/1	0/0
50 (45–54)	8/25	2/2	7/1
60 (55–64)	16/37	8/30	21/20
70 (65–74)	10/16	13/28	84/52
80 (74–84)	0/8	14/22	52/41
90 (84–92)	0/0	0/1	4/5
Total	104/105	37/84	168/119

1. New users of hearing aids
2. Decided to purchase/trial hearing aids.
3. Be over 45 years old
4. Able to return for follow-up appts.
   & proceed through aid fitting procedure
5. Comfortable with computer use

Assessments prior-to & following the finalization of a standard aid fitting:

1. Questionnaires surveying perceived hearing handicap & hearing aid benefit
2. Selective attention & working memory abilities

Participants – control group

1. Also over age 45 years
2. Participants age & gender-matched
3. Never worn hearing aids
4. Comfortable with computer use

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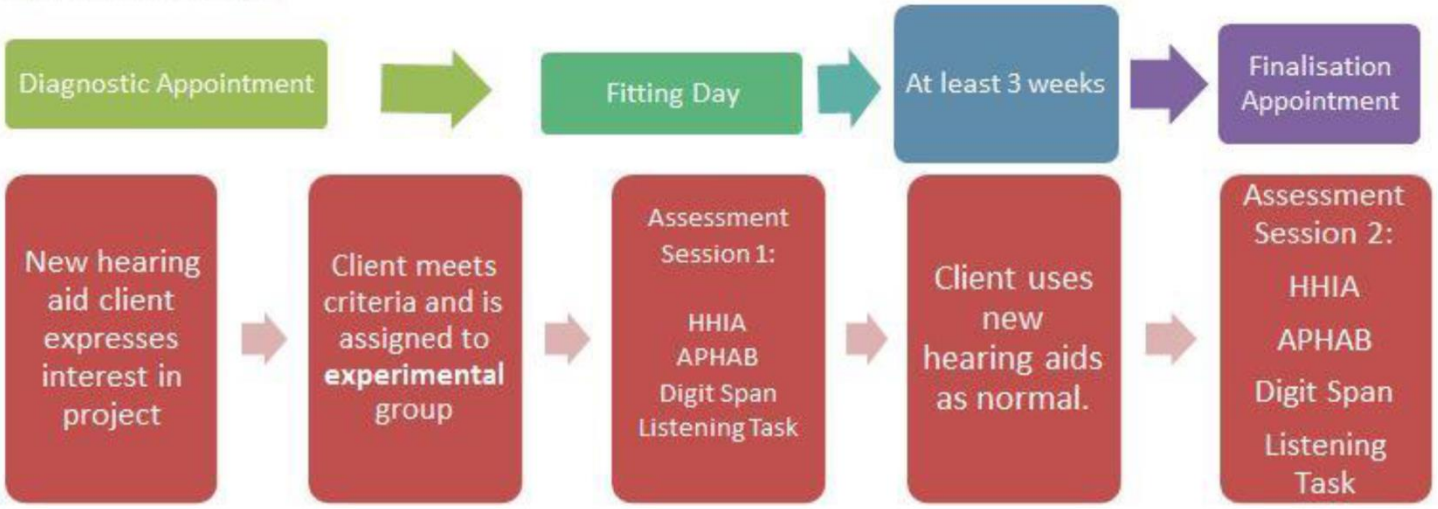
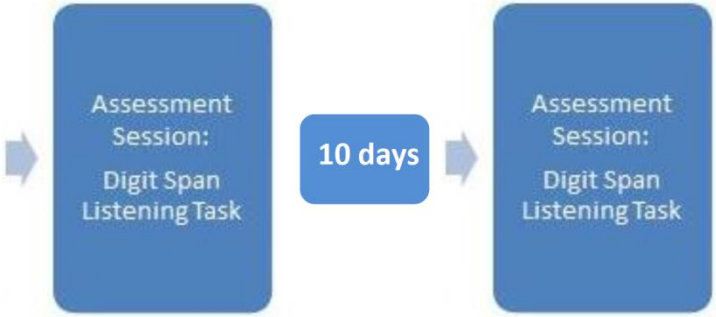
1 **Experimental Group:**



2 **Control Group:**

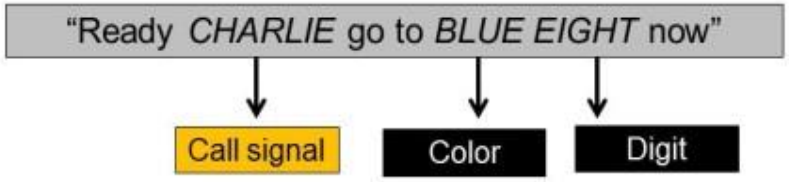
3 **Normal Hearing:**



Methods: selective attention (Humes et al., 2006)

To study people's ability to focus their attention while hearing conflicting information we will present you with **TWO** phrases that contain conflicting information. The phrases will be played at the SAME TIME.

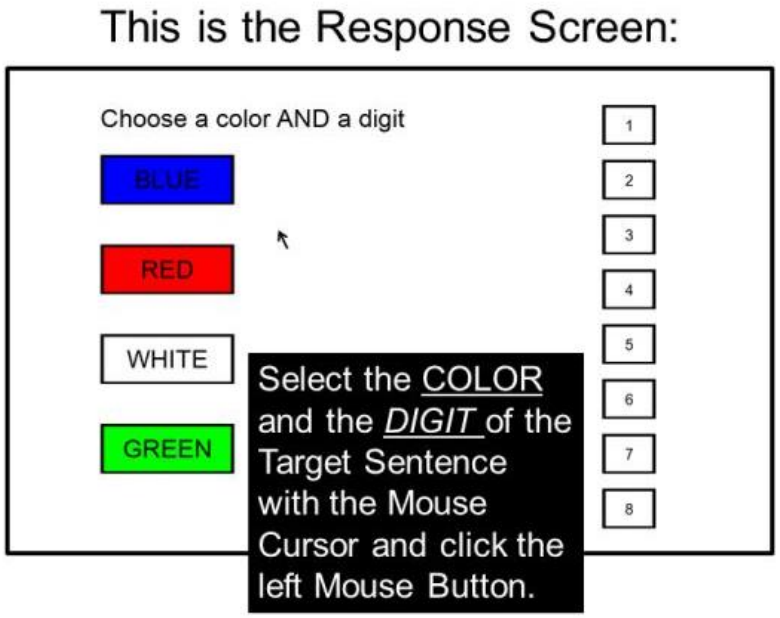
Each of those phrases are similar to:



Each sentence contains a **CALL SIGNAL** (e.g. "Charlie") and information about a **COLOR** (e.g. "Blue") and a **digit** (e.g. "8").

Each sentence has its own call signal, its own color and its own digit. They are *never* the same.

Methods – data acquisition



Familiarisation phase

Methods: working memory

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The following practice is to familarize you with the FORWARD assessment.

(1) You will first see a red circle on the screen.

(2) Once the circle is erased, you will HEAR a sequence of digits from 1-9.

(3) Another red circle signals the end of the digit sequence.

(4) a textbox is presented in the middle of the screen.

Please type in the digit sequence you heard in THE ORDER it was presented, i.e. if you heard (three, six, two) type 362 into the textbox.

NO data will be recorded during the practice.

Please, continue when you are ready.

Continue

Progress summary:

All data has not been collected for all groups seeking N = 24 for all groups:

- 6 participants from the experimental group have been processed fully (Mean age 70.83 years; 3 female, 3 male)
- 11 participants from the control group have been processed fully
- (Mean age 71.64 years; 6 female, 5 male)
- 5 from the normal-hearing group have been partially processed

Results – how do things look so far?

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- The aided group appears to have definitely improved in terms of reaction time for the selective attention task…
- However, we need to analyze their results against our control group and normal group, to factor out any potential procedural learning effects, to determine significance.
- The control group does not appear to have improved as much as the aided group, but this could change with the full complement of data
- At this stage, the working memory task does not appear to be as sensitive an index for potential cognitive improvements with aging but this may change once all data is collected and analysed

Thank you

MEDICAL AND HEALTH SCIENCES

Celebration and showcase of hearing and vestibular research in New Zealand

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Thank you to the University of Auckland for the opportunity

Thank you to:

Our participants,
University of Canterbury's Department of Communication Disorders,
and the Audiology team

References & websites:

- **Slide 2:** Klingberg, T. (2010). Training and plasticity of working memory. *Trends in Cognitive Sciences*, *14*(7), 317–324.
- **Slide 2:** http://www.highiqpro.com/working-memory-training
- **Slide 2:** http://spectrumnews.org/news/cognition-and-behavior-brain-maps-direct-our-attention/
- **Slides 2 & 3:** Fabiani, M., Zimmerman, B., & Gratton, G. 2013. Chapter 11: Working memory and aging: A review. In: Jolicceur, P., Lefebvre, C. & Martinez-Trujillo, J., Eds. Mechanisms of Sensory *Working Memory Attention and Performance XXV*. Academic Press, Elsevier, London, UK.
- **Slide 3:** http://www.medaus.com/news/lower-normal-serum-tsh-level-associated-development-progression-cognitive-impairment-including-mild-cognitive-impairment-dementia-elderly-result-korean-longitudina/
- **Slide 3:** http://news.stanford.edu/news/2014/november/youthful-book-harrison-111914.html
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- **Slide 3:** Grady, C. (2012). The cognitive neuroscience of ageing. *Nature Reviews Neuroscience*, 13(7), 491-505.
- **Slide 4:** Yang, S., Su, W., Bao, S. (2012). Long-term, but not transient, threshold shifts alter the morphology and increase the excitability of cortical pyramidal neurons. *Journal of Neurophysiology*, 108(6), 1567-1574.
- **Slide 4:** Lin, F. R., Metter, E. J., O'Brien, R. J., Resnick, S. M., Zonderman, A. B., Ferrucci, L. (2011). Hearing loss and incident dementia. *Arch Neurol.* 68(2), 214-220.
- **Slide 4:** Lin, F. R., Yaffe, K., Xia, J., Xue, Q.-L., Harris, T. B., Purchase-Helzner, E. P., Sattersfield, S., Ayonayon, H. N., Ferrucci, L. Simonsick, E. M. (2013). Hearing loss and cognitive decline among older adults. *JAMA Intern med.* 173(4): doi: 10.1001/jamainternmed.2013.1868
- **Slide 9:** Humes, L. E., Lee, J. H., Coughlin, M. P. (2006) Auditory measures of selective and divided attention in young and older adults using single-talker competition. *J. Acoust. Soc. Am.* 120(5), 2926–2937
- **Slide 9:** http://www.millisecond.com/download/library/
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